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Typhoid fever in Michigan in 1890.

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TYPHOID FEVER

IN MICHIGAN IN 1890,

A SUMMARY FROM REPORTS

BY

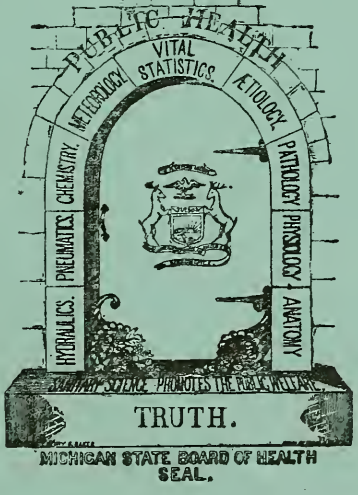
HEALTH OFFICERS, CLERKS AND PHYSICIANS,

COMPILED UNDER THE DIRECTION OF THE

SECRETARY OF THE MICHIGAN STATE BOARD OF HEALTH.

[REPRINTED FROM THE ANNUAL REPORT OF THE MICHIGAN STATE BOARD OF HEALTH FOR THE YEAR 1891.]

[Reprint No. 382.]



MICHIGAN STATE BOARD OF HEALTH SEAL.

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TYPHOID FEVER IN MICHIGAN

DURING THE YEAR ENDING DECEMBER 31, 1890.

[Reprinted from the Annual Report of the Michigan State Board of Health for the year 1891.]
[REPRINT NO. 382.]

There were reported to the office of the Secretary of the Michigan State Board of Health, during the year 1890, 1,924 cases of sickness, and 304 deaths from typhoid fever, in 310 localities. No reports of this disease were received from the following sixteen counties: Alcona, Alger, Arenac, Crawford, Gratiot, Iosco, Iron, Isle Royal, Luce, Mackinac, Manitou, Missaukee, Montmorency, Ogemaw, Presque Isle, Schoolcraft.

Table 1 gives, relative to typhoid fever, the number of outbreaks, localities, cases, and deaths, average number of cases per outbreak, average number of deaths per outbreak, per cent ratio of deaths to cases, and the number of special final reports received, for the seven years, 1884–90:

TABLE 1.—TYPHOID FEVER.—*Exhibiting the number of Outbreaks, Localities, Cases and Deaths reported for each of the seven years, 1884–90; also for some of those years the average Cases and Deaths per Outbreak, the per cent ratio of Deaths to Cases, and the number of Special Final reports received.*

Year.	Outbreaks Reported.	Localities Reported.	Cases Reported.	Deaths Reported.	Average Cases per Outbreak.	Average Deaths per Outbreak.	Deaths per 100 Cases.	Final Reports Received.
1884	----------	245	969	290	----------	----------	27	----------
1885	218	200	715	194	3.28	.89	23	----------
1886	290	282	1,194	282	4.15	.75	18	60
1887	335	320	3,424	411	*7.24	*1.23	.17	46
1888	316	296	1,511	310	4.78	.98	21	60
1889	432	398	2,530	402	†5.17	†.93	†18	115
1890	330	310	1,924	304	5.83	.92	16	135

* The large average number of cases and deaths per outbreak in 1887 is partially accounted for by the fact that in two outbreaks the disease became epidemic, resulting in an aggregate of 535 cases and 73 deaths.

† In computing the average numbers of cases and deaths per outbreak, and the per cent ratio of deaths to cases in 1889, the outbreak at Negaunee, in which 300 cases were reported, is omitted, because the number of deaths which occurred in that outbreak was not reported.

As shown in Table 1 there were reported to this office 606 cases and 98 deaths less for the year 1890 than for the preceding year. The average number of cases per outbreak for the year 1890 is slightly more than for 1889. This is explained in part by the fact that, during the year 1889,

there occurred an epidemic of this disease, at Negaunee, with 300 cases, which, as stated in the (†) foot-note to Table 1, were not computed in the average for that year.

The reports received at this office show this disease to have been slightly less fatal during the present year than for the preceding year, the number of fatal cases being 2 per cent (of the total number of cases) less in 1890 than in 1889.

In 1889 the number of reported cases per 10,000 of population was 12.4, in 1890 it was only 9.2.

Notwithstanding the large decrease in the number of reported outbreaks of this disease in 1890, as compared with 1889, there is shown by Table 1, an increase in the number of final reports received at this office relative to those outbreaks. This indicates a gratifying increase of assiduity on the part of local health officials in the discharge of their duties.

Study of the regular sickness-statistics in Michigan (conclusions from which are given in Exhibit 1 and Table 8, further on in this article) shows a decrease in the per cent of weekly reports which stated the presence of typhoid fever in 1890, as compared with 1889, which is corroborative of the evidence of the decrease in prevalence of the disease as shown (in Table 1 and the last three preceding paragraphs) by the system of communicable disease reports on which the first part of this article is based.

SOURCE OF CONTAGIUM OF TYPHOID FEVER.

TABLE 2.—*Exhibiting the reported "Source of Contagium" of Typhoid Fever in Michigan, during the year 1890.*

Reported Source of Contagium.	Number of Reports for each Source of Contagium.
Infected and impure water	54
Supposed to be impure water	5
Unsanitary surroundings	13
Defective drainage and sewers	3
From a former case	7
From outside jurisdiction whence reported	47
Decaying vegetables in cellar	2
Overwork	4
Digging a ditch	1
Unknown	68
No source stated	111
Sporadic	7
Exposure	5
Bad atmosphere	1
In milk	1
By working on Port Huron tunnel	1
All outbreaks	330

Table 2 shows that relative to 111 of the 330 outbreaks of typhoid fever reported to this office during the year 1890, the source of contagium was not stated, that in regard to 68 outbreaks it was reported as "unknown," and that in 47 instances it was reported as having been brought from outside the jurisdictions whence the outbreaks were reported. In 52 per cent of the remaining 104 outbreaks the source of contagium was given as "infected and impure water," and in 13 per cent as "supposed to be impure water."

Below are given extracts from statements found in the reports of local health officers with regard to the source of the contagium of typhoid fever.

"Most probably the use of water from a shallow creek to which geese, dogs, cats, cows, horses, men, women and children, both dead and alive, have free access."—*Geo. G. Barnett, M. D., Health Officer of Tilden township, Marquette county.*

"Investigating the source of this outbreak of Typhoid Fever, I found the well under the house, dug well, stoned up, about two feet of filthy water containing dead rats, sow bugs and filth from scrubbing floors. Hog yard, hen park and privy all within fifty to seventy-five feet of the well."—*H. C. Maynard, Health Officer of the Village of Hartford, Van Buren county.*

"From filth of cistern and reservoir, under the dwelling house, large enough to contain water for the use of 500 cattle in time of a drouth."—*Alexander C. Kidd, Health Officer, Albee township, Saginaw county.*

"This patient contracted the disease while engaged as a sailor. The vessel on which he was working lay in Detroit at the outlet of a sewer. He drank of the water."—*W. K. Moore, Health Officer, Algonac, St. Clair county.*

"This fever has prevailed here every year during the summer and autumn for the past six years, and very little, if anything has been done to prevent the ravages of the disease. Much of the land in and around about the town is low and swampy and the drainage and natural water courses are blocked up with slabs and saw dust along the whole front of the town. Water is obtained from two sources, water pipes in L'Anse Bay, and surface wells. The water pipes draw water from the bottom of a shallow bay, only a short distance from the shore, directly in front of two saw mills, and only a few feet from large docks built of mill waste. In summer the water always has a bad odor. As to the wells, water can be obtained anywhere by digging a few feet. After a heavy rain wells and shallow privy vaults are running over so that pollution of the well water is very general; and this is increased by lack of drainage."—*A. J. Braden, Health Officer, Baraga township, Baraga county.*

The following diagram, on page 212, drawn from sketches and information furnished by Mr. Braden, illustrates the conditions under which the water-supply of Baraga is obtained; which conditions seem to fully warrant the opinion that the source of the disease in Baraga was polluted drinking water.

TYPHOID FEVER AT SAULT STE. MARIE.

The following correspondence between the Secretary of this Board and Dr. A. J. Campbell, health officer of Sault Ste. Marie, bears on the source of contagium, and history, of an outbreak of typhoid fever which prevailed at that place from August to October, 1890, and which resulted in 300 cases of sickness and 20 deaths. It also illustrates some of the difficulties with which health officers have to contend in their efforts to restrict and stamp out dangerous communicable diseases which appear in their jurisdictions.

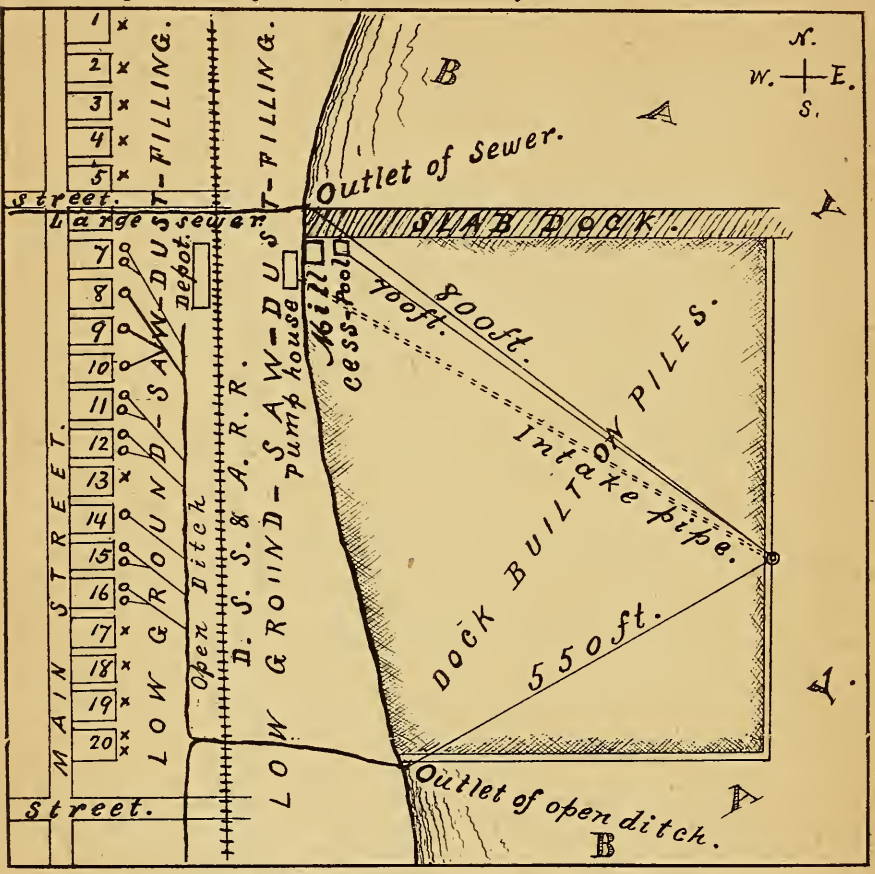
August 28, 1890, Dr. Campbell wrote to the Secretary as follows:

"I forward you a notice of an outbreak of typhoid fever. I will send you a fuller report soon. The physicians *will not* report. The prosecuting attorney will not prosecute for want of evidence. I can go and diagnose typhoid fever; the physician in attendance says no. I'll get three to say yes; he will get six to say no. The prosecuting attorney says, no evidence. Your health officer is ignominiously defeated. No remedy. My salary is $13.33 per month. Who can attend to his duty under such circumstances. I wish I had the power to get others to do their duty, and I would not mind it so much. I would like to hear from you in regard to the matter. I have the law; but I cannot get the prosecuting attorney to act.

* * * * * * * * * *

"Send a few of 'The Prevention of Typhoid Fever.'"

Plat of a portion of the Village of Baraga, Michigan. Showing unsatisfactory location of water intake.



1, 2, 3, 8, 9, 10, 11, 12, 14, 15, 16, 17, 18, = Dwellings.
7, = Boarding-house, where 9 or 10 cases of Typhoid Fever occurred.
X, = Shallow privy-vaults.
O, = Water-closets with leaky box-drains emptying into open ditch.
◎:::::::, = Intake pipe for water works which supply all the houses except "2" and "3".

In reply to the foregoing letter the Secretary wrote to Dr. Campbell, Sept. 13, 1890:

"I have mailed to your address 40 documents on "The Prevention of Typhoid Fever," for distribution among those in your city who are in danger.

"I also sent you several copies of a document on 'Typhoid and Typho-Malarial Fevers' (a copy of which I herewith enclose) which it would probably be well for you to distribute among the practicing physicians in your jurisdiction.

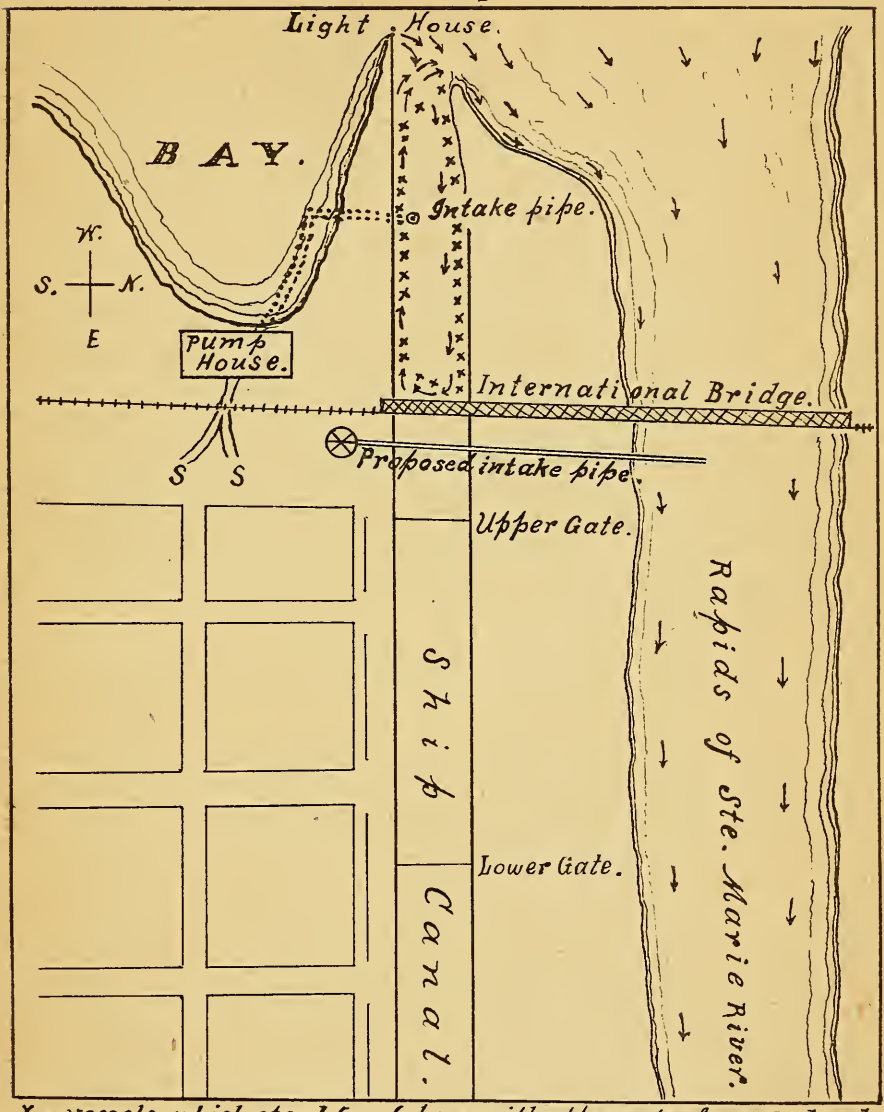
"I trust that your local board of health will vigorously endeavor to stamp out typhoid fever in your city."

November 18, 1890, the Secretary again wrote to Dr. Campbell as follows:

"Will you kindly send me all the information you can concerning the outbreak (in August) of typhoid fever in your city, and *its relations to the detention of boats*, etc.?

"I will also be glad to receive your final report of the outbreak when it is over."

Plan of a part of the City of Sault Ste. Marie



X = vessels which stood 5 or 6 days with upper gate of canal closed. Arrows show current of water in canal when the upper gate is closed.

Map of conditions in Sault Ste. Marie, Michigan, where an outbreak of typhoid fever occurred. Water for domestic purposes was used from the canal when a large number of vessels were detained five or six days with canal closed while the locks were being repaired. During that time garbage and fæcal matter were continually thrown into the canal from these vessels.

In reply to the last preceding letter, Dr. Campbell wrote:

"In compliance to your request regarding the history of the typhoid fever outbreak in the city of Sault Ste. Marie last summer: The fever made its appearance immediately after the canal locks were repaired. In my monthly report to our city council I called attention to the impurities of the water used for domestic purposes during the time the canal was closed, and when between three and four hundred vessels were detained during the space of five or six days. We sent samples of water to Dr. Vaughan, Michigan University, for analyses. He discovered disease germs—typhoid fever germ, and having collected the poison from the specimen sent, injected, hypodermically, the same into the abdomen of a rat, result, death. One month after the fever began to abate, I sent specimens from the cataract pump house, and from a tap in the most distant point from the pump house, marking them Nos. 1, 2 and 3,—result, pure, no disease germ, no poison.

"I enclose you a diagram of the water works, or pump house, cataract and canal. There were about three hundred cases of typhoid and typho-malarial fevers; probably 20 deaths. The fever began about two weeks after the canal was opened. First case reported to me in August, the last on the 20th October.

"I trust the State Board of Health will urge, with effect, the propriety of every town and city having a board of health. The council too often are under political obligations that bind them hand and foot."

"The water in the bay where the pump house is situated is almost dead water. The intake pipe runs through the south pier of the canal into the canal. You will observe the indication of the course of the water. The current runs into the rapids past the canal; but a small current runs into the canal and turns back if the upper gate is closed, and catches the current running into the rapids. x x x x show where the vessels were standing for five days dumping out diseased garbage and fæcal discharges while the locks were being repaired. The water thus saturated was taken by the intake pipe and thus supplying the city by way of S. S. I recommended carrying the intake pipe (to be carried from a pump house erected at (⊕)) to the center of the rapids, and be no longer at the mercy of an accident on the canal locks."

In thanking Dr. Campbell for his report, as given above, the Secretary wrote:

"In reference to the intake of the water-supply of your city, how would it do to place it beyond the light house, in the river, just above where it could receive any water from the canal? If below the bridge it would still take in some water which came from the canal."

Following are a diagram (drawn in this office from the one referred to in the above letter) and explanations thereof, given by Dr. Campbell, which graphically portray the conditions under which the water supply of Sault Ste. Marie, believed to have been the cause of the outbreak of typhoid fever there, was obtained:

TYPHOID FEVER IN HARTFORD, VAN BUREN COUNTY.

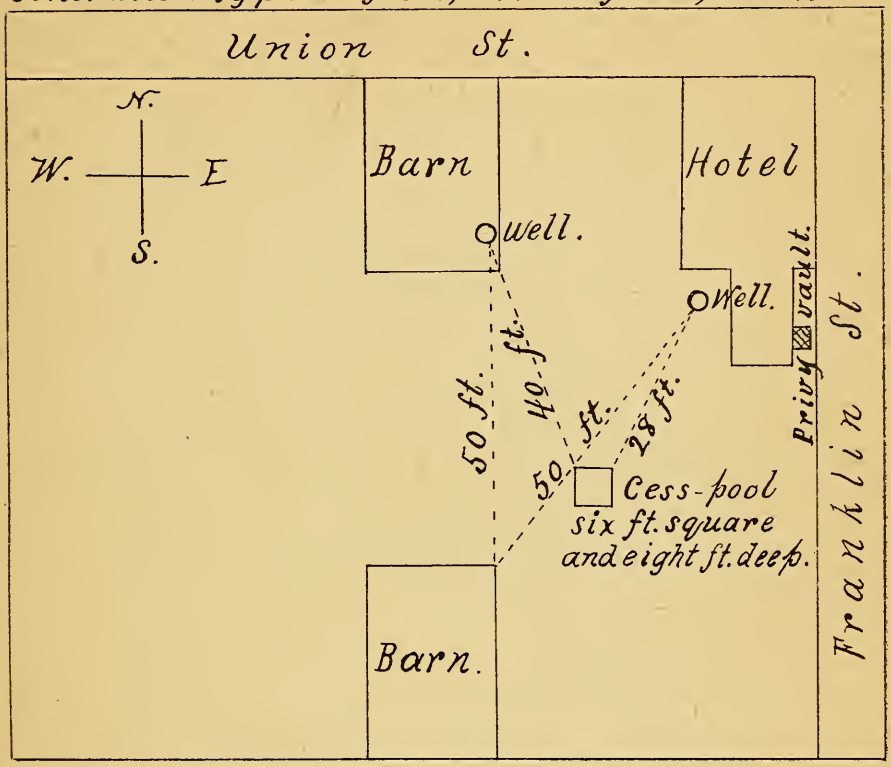
Relative to an outbreak of typhoid fever in the village of Hartford, of which the source of contagium was believed to be impure drinking water, Dr. H. C. Maynard, health officer of the village, wrote to this office as follows:

"The case of typhoid fever reported, is a young man that has been boarding at the principal hotel of this village all summer. I procured and tested the water furnished the guests of the house and find it a mass of organic matter.

"I send you diagram of the water supply."

Following is a diagram made in this office, from the one referred to in Dr. Maynard's letter.

Impure source of water used by person who contracted typhoid fever, in Hartford, Mich.



INFECTED MILK THE SUPPOSED CAUSE OF TYPHOID FEVER IN WYANDOTTE.

Sept. 28, 1890, Dr. E. P. Christian, of Wyandotte, Wayne county, wrote to the Secretary of this Board relative to typhoid fever in that city as follows:—

"Typhoid fever has been with us this fall unusually prevalent and of more than common severity. This is rather severe on the doctors of our city who advocated getting in water works as a sanitary measure in this respect. We had the river water introduced a year ago this fall, and to have had such an increase in number and severity of cases since its introduction has led to the surmise that we had been introducing to our houses the diluted sewage of Detroit. Perhaps this is so to some extent, for the solid parts no doubt settle to the bottom all along down, and when a heavy wind prevails the water from the penstocks is at times decidedly roily and off color.

"However, the fact is that the disease has prevailed as to numbers, about equally among users of well water and of river water—giving rise to the suggestion that we must look elsewhere for the cause of the disease than in the drinking water.

"This I have suspected for a long time and have had a suspicion that this cause was in the milk.

"I have had an experience within the past two months which has strengthened that suspicion.

"In the family of Mr. A. two cases of enteric fever, and all the family ailing—in the family of T. three (3) cases and others ailing, one deceased. In the family of Mrs. F., one severe case—all these in immediate neighborhood—all it is true using river water, but all getting milk from one cow, a neighbor's—also in Dr. C.'s practice in family of Mr. T., one case getting milk from same cow, but also using river water. This animal is stall-fed, kept up in barn. To be sure there have been many other cases of fever in those using well water and milk from other sources. But is it not singular that so many cases have occurred in one small neighborhood and all getting milk from the same animal?

"It would be worth while for the Board of Health to purchase this animal and investigate her."

Sept. 30, 1890, the Secretary sent to each member of this Board a copy of Dr. Christian's letter accompanied by the following from himself:—

"Dear Sir:—I shall be glad to receive any suggestions which you will make on the subject of the above letter from Dr. Christian."

Samples of the milk, of the river water, and of the well water were sent to Prof. Vaughan, Director of the Laboratory of Hygiene, Ann Arbor; and at the meeting of this Board Oct. 14, 1890, he made a verbal preliminary report that bacteriological examination revealed the fact that both of the samples of water and the milk contained micro-organisms which, by their life processes, in nutritive solutions, form poisons.

At the same meeting Drs. Vaughan and Kellogg were appointed a committee to further investigate this subject; and later, Dr. Vaughan reported as follows relative to analyses of waters and milk sent to him from Wyandotte:

MICHIGAN UNIVERSITY—LABORATORY OF HYGIENE.

Report of the Sanitary Condition of Water sent by E. P. Christian, M. D., Wyandotte, Michigan:

Source of water, with remarks on the sanitary surroundings.

No. I.—From H. Millspaugh's well. No. II.—From Water Works.

PHYSICAL PROPERTIES.

	No. I.	No. II.
Color	Sedimentary	Clear.
Odor	None	None.
Reaction	Neutral	Neutral.
Hardness	13	7 (Clark's Scale.)

Chemical Analysis (Parts per Million.)

(1)	Total residue obtained by evaporation at 110 C	1090.	221.
(2)	Residue after ignition, or inorganic matter in residue	850.	191.
(3)	Organic residue, or loss on ignition	240.	30.
(4)	Amount of earthy bases, calculated as oxides	20.798	10.976
(5)	Amount of chlorine, calculated as sodium chloride	266.4	49.5
(6)	Amount of sulphates calculated as SO_3	Strong trace	None.
(7)	Parts of potassium permanganate reduced by the organic matter in the water	41.08	32.548
(8)	Amount of free ammonia	0.46	0.08
(9)	Amount of albuminoid ammonia	0.56	0.52
(10)	Amount of nitrates, calculated as N_2O_5	13.06	0.653
(11)	Amount of nitrites, calculated as N_2O_3	0.247	0.0082

* * * * * * * * *

Microscopical Examination.—Description of deposit, magnified 100 diameters. No. I. Crystals. Yellow amorphous matter. White amorphous matter. No. II. Crystals. Algæ. Yellow amorphous matter. White amorphous matter. Same magnified 500 diameters. No. I. Sodium chloride crystals. Algæ. Yellow amorphous matter. White amorphous matter. No. II. Sodium chloride crystals. Silica. Fibres. Algæ. Vorticellæ. Yellow amorphous matter. White amorphous matter.

Bacteriological Examination.—Number of germs developed on a gelatin plate inoculated with one drop of water:

	No. I.	No. II.	Milk.
(1) After 24 hours	2430	1770	3460
(2) After 48 hours	2580	1890	3460
(3) After 72 hours	2580	1890	3460

Remarks on the Kinds of Germs Observed.—In No. I. are two kinds of germs: (a) the green bacillus of water, and (b) a non-liquifying toxicogenic germ. In No. II. are two kinds of germs: (a) the green bacillus of water, and (b) a liquifying toxicogenic germ. In the milk there are three or four kinds of germs, among which there is the same non-liquifying toxicogenic germ found in the well water.

Inoculation Experiments.—Kind of animal inoculated with the germs: Rats. Method of inoculation: By injection into the peritonial cavity. Kind, amount, and age of culture used: Twenty drops of a beef-tea culture 24 hours old. Results of the inoculation: Death with all the samples. Post-mortem appearances: These were practically the same with all samples, and consisted of engorgement of the spleen, the mesenteric glands, liver and kidney. Description of the germs, if any, found in the organs: The toxicogenic germs found in the waters and in the milk were also found in the organs of the animals. In what organs were the germs, if any, found growing? Spleen, liver and kidney.

Explanation.—One drop of the water is added to one drachm of some culture medium, such as beef-tea, and this, after it has been kept at the temperature of the body for 24 hours or longer, is used for inoculating animals.

Conclusions.—I regard both the waters and the milk unsafe. Of the two waters, that from the well is the worse both chemically and bacteriologically. The milk was examined only bacteriologically. The poison-producing germ in the well water is identical with that in the milk. I am inclined to the opinion that if the typhoid fever was due to one of the waters, the well water is the one more likely to be the cause. Eberth's germ (the so-called typhoid germ) was not found in any of the samples. This, however, does not mean, in my opinion, that the waters would not cause the typhoid fever. I have never yet found Eberth's germ in drinking water (with one possible exception). The river water probably has changed in its character since the sample was taken, but the well water certainly should not be used.

V. C. VAUGHAN,

Director of the Michigan State Laboratory of Hygiene.

Ann Arbor, Nov. 12, 1890.

TABLE 3.—*Exhibiting the Localities from which Typhoid Fever was spread (according to the official reports), with the number of Cases and Deaths, if reported; the Secondary Localities into which the Disease was said to have been Introduced from the First (with number of Cases and Deaths.) Compiled from Reports by Health Officers who were able to trace the source of Contagium to other Localities.*

First Localities from which Typhoid Fever Spread.	In "First" Localities.		Secondary Localities infected from "First."	In "Secondary" Localities.	
	Cases.	Deaths.		Cases.	Deaths.
Antrim county: Torch Lake township	6	2	Antrim county: Central Lake township	9	0
Baraga county: Pequaming, L'Anse township	*	------	Houghton county: Lake Linden village	4	1
Berrien county: Berrien Springs village	*	------	Berrien county: Berrien township	3	0
Calhoun county: Battle Creek city	5	2	Calhoun county: Beford township	1	0
			Barry county: Barry township	2	0
Cass county: Dowagic city	8	0	Van Buren county: Keeler township	1	0
Emmet county: Petoskey village	*	------	Lenawee county: Morenci village	1	0
Gogebic county: Bessemer city	*	------	Ontonagon county: Rockland township	1	0
Hillsdale county: North Adams township	*	------	Jackson county: Liberty township	1	0
Houghton county: Calumet village	72	0	Ontonagon county: Rockland township	1	0
Ingham county: Stockbridge village	20	2	Ingham county: Dansville village	2	0
			Ingham township	1	1
Kent county: Grand Rapids city	193	30	Allegan county: Allegan township	2	0
			Kent county: Cannon township	2	0
			Cascade township	11	3
Leelanaw county: Empire township	1	0	Leelanaw county: Glen Arbor township	2	0
Lenawee county: Adrian city	9	2	Lenawee county: Dover township	2	0
Lenawee county: Rollin township	1	0	Lenawee county: Rome township	6	2
Mecosta county: Big Rapids city	29	2	Muskegon county: Muskegon city	15	5
Oscoda county	*	------	Sanilac county: Marion township	2	0
Presque Isle county	*	------	Cheboygan county: Tuscarora township	4	1
St. Clair county: St. Clair city	1	1	St. Clair county: Columbus township	1	0

* This outbreak was not reported to this office by the Health Officer of the "first" locality at the time it occurred. This shows neglect in the locality from which the disease spread.

TABLE 3.—CONCLUDED.—*Exhibiting the Localities from which Typhoid Fever was spread.*

First Localities from which Typhoid Fever Spread.	In "First" Localities.		Secondary Localities infected from "First."	In "Secondary" Localities.	
	Cases.	Deaths.		Cases.	Deaths.
St. Clair county: Port Huron city	*		Huron county: Verona township	4	0
Wayne county: Detroit city	39	10	Lenawee county: Morenci village	1	0
			Macomb county: Richmond village	1	0
			Romeo village	1	0
			Oakland county: Rose township	1	1
			Wayne county: Hamtramck township	9	2
Adjoining township	*		Saginaw county: Albee township	2	0
(Outside the State.)					
Canada			Tuscola county: Gilford township	1	0
Chicago			Kalamazoo county: Schoolcraft township	2	2
			Macomb county: Richmond village	1	0
Colorado			Shiawassee county: Perry township	1	1
Illinois			Hillsdale county: Ransom township	4	1
Burdick, Indiana			Lenawee county: Clayton village	3	0
Garrett, Indiana			Lenawee county: Morenci village	1	0
Montana			Livingston county: Deerfield township	1	0

* This outbreak was not reported to this office by the Health Officer of the "first" locality at the time it occurred. This shows neglect in the locality from which the disease spread.

In the following instance the contagium was reported to have been carried to a third locality:—

From Pequaming, L'Anse township, Baraga county to Lake Linden village, Houghton county, thence to Torch Lake township, Antrim county.

EFFORTS FOR THE PREVENTION AND RESTRICTION OF TYPHOID FEVER.

It is gratifying to note that the increased interest on the part of local health officers in carrying out the preventive and restrictive measures recommended by the State Board of Health in outbreaks of typhoid fever mentioned in the Annual Report of this Board for 1890, is again apparent this year, and that many of those officials have been very zealous in efforts to induce physicians to report cases of that disease occurring in

their practice, to obtain amelioration of the water-supply in localities where typhoid fever has occurred, and in advocating the introduction of measures calculated to improve the sanitary conditions in their jurisdictions.

The following extracts from letters and reports received at this office illustrate the nature of the efforts made by those officials and show that those efforts are not always made under the most encouraging or favorable circumstances.

"I am doing all that I can in the way of disinfection of all bowel discharges, cleanliness, etc. and whenever I can prevail upon them to do so, I have all drinking water boiled. The population is largely foreign. There is very little public sentiment in favor of improvement, and only a small minority that will give any encouragement or coöperation in that direction."—*A. J. Braden, Health Officer, Baraga township, Baraga county.*

"Inclosed please find final report of those cases reported. They are all well and I have been able to make the owner of the house in which those cases were, understand that it was his duty to tear the house down. The house is old and is built on saw dust which has been there for years and which would surely cause some other troubles before long. I have found out that years ago, about four or five years, people living in the same house, died of a disease not recognized then, but which seems to me to be the same as the one reported as typho-malarial."—*Melville E. deLaval, M. D., Health Officer, Schoolcraft township, Houghton county.*

"Drains opened, cleaned and disinfected. Privy vaults cleaned. Cellars drained."—*A. J. Braden, Health Officer, Baraga township, Baraga county.*

"Your enclosed circular and other documents duly received. In reply would say that we have had eleven cases of fever in this location this year. The last case of which is now ready to be returned to his home. Our fever is cared for here in our hospital by experienced nurses, in a ward devoted exclusively to their use, where they are protected from officious friends. Their diet intelligently administered, the soiled clothing placed in disinfecting fluid on the same floor, the sputa received in sanitary cups and burned, the excreta received in disinfecting fluid and placed in barrels at remote points in disinfecting fluid, and, next month when frozen, removed beyond possible chance of communication. As the season seemed to be prolific with fever, we had in readiness a large hall, capable of holding fifty beds, should our hospital be overtaxed.

"Our reason for caring for our people in this manner is due to the fact, that since 1883 we have had no case of fever originate in our location. Previous to and including that date, fever was a common and constant visitor, in the latter year reaching eighty cases. Our mining officers with myself, drafted sanitary rules, the cleaning of wells, ordering garbage and slops placed in pits remote from the wells, the filling and disinfecting of vaults, the cleaning of cellars under the rigid daily inspection of a proper officer, as a means of purifying the ground surface and the protection of our water supply which is from the surface entirely. Every year from the interchange of employés coming from infected districts, we are the victims of transplantation of fever and for the avoidance of seed sowing, such cases are, as soon as discovered, removed where the details of restriction can be carefully carried out, and, from the fact that so far, in the time named, we can trace the neighboring point from which the patient came; and that we have yet to record a case as being infected from any extension of the disease, speaks plainly the result of the attention given it.

"We have no municipal organization here, all measures being under the control of the mining company, whose representatives are the township officers, and I cannot too highly compliment the manager and officers of the mining company for the intelligent and cheerful accord by which is made possible such sanitary and life-saving methods."—*I. Freund, M. D., Health Officer, Champion township, Marquette county.*

DIFFICULTIES EXPERIENCED BY LOCAL HEALTH OFFICERS IN RESTRICTING TYPHOID FEVER.

Some of the difficulties which local health officers experience in the performance of the duties required of them by law, are shown by the following extracts from correspondence of this office with those health officers in regard to typhoid fever:

Alvinza C. Merrill, M. D., Health Officer of Harbor Springs, Emmet county, reports, relative to an outbreak of typhoid fever, as follows:—

"The attending physician did not inform me, nor did he report the cases to me as he should have done."

In reply to the question "What exceptions were there to the complete accomplishment of the disinfection of excreta, boiling of water, etc.," in an outbreak of typhoid fever, N. D. Lee, M. D., Health Officer of Saginaw, West side, wrote:—

"None, when it was reported by a physician; but they do not report more than half the cases. I get more than half of the cases through newspapers, after they are dead or well."

F. M. Kerry, Health Officer of Benton Harbor, Berrien county, reported in regard to an outbreak of the disease:—

"Three families were reported by well founded rumor. In two of these deaths occurred. The physicians did not report cases. My attention would be called to the fact by rumor or funeral notice. Physicians claimed disease was typho-malarial or bilious remittent fever.

"Have not had a case of typhoid reported to me by a physician."

N. B. Sherman, M. D., Health Officer, Waterloo township, Jackson county, reporting in regard to typhoid fever, wrote:—

"I have learned in a casual way of the death of Jas. Rowe, Mrs. Hall, and Henry Arty. The attending physicians were Dr. Rowe, of Stockbridge; Dr. Condon, Munith; Dr. Raymond, Grass Lake. These cases have not been reported to me. * * * * Possibly these Drs. before mentioned do not understand their duty."

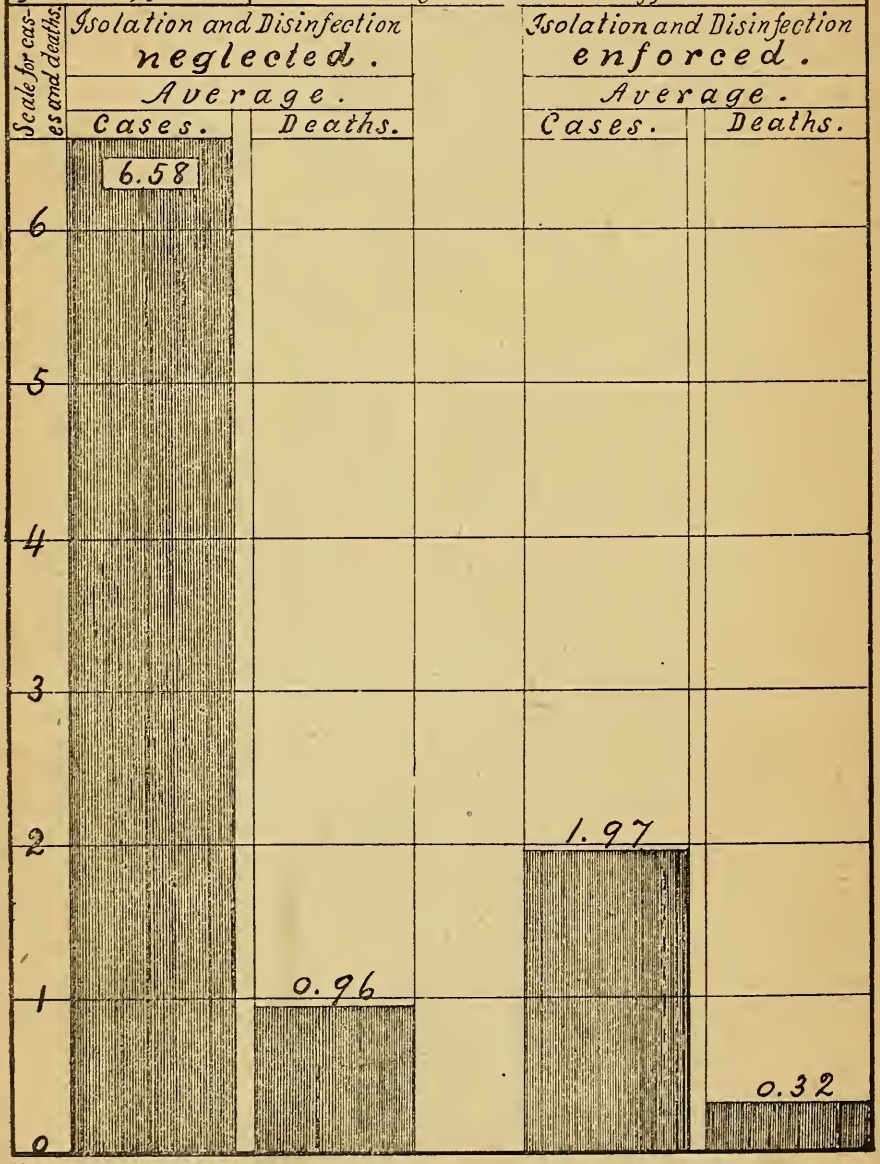
In studying the effects of efforts of health officers for the restriction and prevention of typhoid fever, and of the difficulties experienced by some of them in carrying out the methods recommended by the State Board of Health to that end; it is interesting to note the difference in the reported numbers of cases of sickness and of deaths, from this disease, in outbreaks where local health officers were enabled to enforce isolation and disinfection, and in those outbreaks in which, for any reason, those restrictive measures were neglected.

The diagram on page 222 graphically illustrates this difference, and shows that in outbreaks relative to which the reports state that isolation and disinfection were enforced, there occurred 1.97 cases and 0.32 of one death per outbreak; whereas in those outbreaks where isolation and disinfection were neglected, there were 6.58 cases of sickness and 0.96 of one death per outbreak; or about three times as many cases and deaths in outbreaks in which isolation and disinfection were neglected, as there were in outbreaks where those restrictive measures were enforced. It therefore seems probable that if proper restrictive measures had been adopted in all the 330 outbreaks of this disease which were reported to this office during the year, with results similar to those obtained in the above-mentioned outbreaks where isolation and disinfection were enforced (1.97 cases and 0.32 of one death per outbreak), there would have occurred only 650 cases of sickness and 106 deaths from this disease in the State during the year, instead of the 1,924 cases and 304 deaths which actually occurred in those outbreaks which were reported; and a saving to the State of 1,274 cases of sickness and 198 lives would have been effected.

This showing seems to present a forcible argument in favor of the adoption of the preventive measures above referred to, and a strong plea for the coöperation of all the people, in the efforts of health officers to stamp out this preventable disease.

ISOLATION AND DISINFECTION RESTRICT TYPHOID FEVER.

Typhoid Fever in Michigan in 1890:-Exhibiting the average numbers of cases and deaths per outbreak:-in all outbreaks in which Isolation and Disinfection were both neglected; and in all outbreaks in which both were enforced: (Compiled in the office of the Secretary of the State Board of Health, from reports made by local health officers.)*



*Including the disinfection of the bowel discharges of the patients.

AVERAGE DURATION OF TYPHOID FEVER.—FATAL AND NON-FATAL CASES.

TABLE 4.—*Exhibiting by Sex of patient, the Average Duration (in days) of Fatal cases of sickness from Typhoid Fever, in Michigan, during the four years, and during each of the four years 1887–90. (Compiled from those reports which stated the length of time the patient was sick.)*

Year.	Fatal cases of Typhoid Fever.	No. of cases included in this table.	Duration of Sickness:—Per cent of Deaths in each Period of Days.											
			All cases.	Under 10 days.	10 to 15.	15 to 20.	20 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 to 55.	55 Days and over.
1887.	Males	81	100	10	7	15	21	16	11	12	2	4	1	0
	Females	32	100	31	19	19	16	6	3	0	0	6	0	0
1888.	Males	40	100	20	13	18	23	10	8	0	5	3	3	0
	Females	33	100	24	21	15	12	9	6	3	0	0	9	0
1889.	Males	42	100	17	14	19	7	14	5	7	2	7	0	7
	Females	51	100	18	24	14	16	10	2	6	2	2	0	8
1890.	Males	57	100	19	9	21	23	5	5	7	0	4	2	5
	Females	26	100	19	23	8	8	19	12	0	8	0	0	4
Av. 1887-90.	Males	220	100	17	11	18	19	11	7	5	2	5	2	3
	Females	142	100	23	22	14	13	11	6	2	3	2	2	3

From Table 4 it may be seen that of the 220 males who were reported to have died from typhoid fever within the four years 1887–90, and of which the interval between the day of being taken sick and day of death was given, the largest per cent died in the two periods from the 15th to the 20th and from the 20th to the 25th day of sickness, and that 54 per cent were sick twenty or more days before they died; while of the 142 females reported as having died in the same time, 23 per cent died before the tenth day, and that only 42 per cent were sick longer than nineteen days.

The average duration for the fatal cases, was in males 22.4 days, and in females 20 days.

In Table 5 it may be noticed that the duration of sickness in *non-fatal* cases of typhoid fever for the four years, 1887–90, was about the same for both sexes; 62 per cent of the males and 64 per cent of the females recovered before the thirty-fifth day of sickness. The average duration was:—males 32.8 days, females 31.5 days.

The average duration of all cases, fatal and non-fatal, was: —males, 27.6 days, females, 25.8 days; and for all cases of both sexes, 26.87 days.

TABLE 5.—*Exhibiting by Sex of patient, by per cent of cases which recovered in specified periods of time, the average duration (in days) of non-fatal cases of sickness from Typhoid fever, in Michigan, during the four years and during each of the four years 1887–90. (Compiled from those reports which stated the length of time the patient was sick.)*

Year.	Non-Fatal Cases of Typhoid Fever.	No. of cases included in this table.	Duration of Sickness:—Per Cent of Cases in each Period of Days.											
			All Periods.	Under 10 Days.	10 to 15.	15 to 20.	20 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 to 55.	55 Days and over.
1887.	Males	203	100	0	5	6	12	16	18	15	9	6	3	8
	Females	158	100	0	9	9	19	12	17	11	6	4	3	9
1888.	Males	164	100	1	4	13	9	13	15	9	10	9	9	7
	Females	111	100	0	2	7	14	15	15	19	4	8	10	8
1889.	Males	166	100	2	7	13	14	16	14	12	9	6	2	5
	Females	165	100	6	8	9	14	19	12	11	8	4	2	7
1890.	Males	226	100	1	4	7	15	18	19	12	10	5	2	8
	Females	110	100	1	4	14	16	17	13	14	9	2	5	6
Av. 1887-90.	Males	759	100	1	5	10	13	16	17	12	10	7	4	7
	Females	544	100	2	6	10	16	16	14	14	7	5	5	8

TABLE 6.—*Exhibiting, by Sex of patient, the Age of persons reported sick from Typhoid Fever, in Michigan, during each of the four years, 1887–90, and the averages for the four years. Also the Average Age, and the Number of cases, in which the age was stated, reported in each of the four years. (Compiled from reports of those cases in which the Age was stated.)*

Year.	Sickness from Typhoid Fever.	Average age. Years.	No. of cases included in this table.	Age,—In periods of Years. Per Cent of Cases in each Period of Age.										
				All Ages.	Under 10 years.	10 to 15.	15 to 20.	20 to 25.	25 to 30.	30 to 35.	35 to 40.	40 to 45.	45 to 50.	50 Years and over.
1887.	Males	24	316	100	10	10	14	20	17	9	8	4	2	4
	Females	22	245	100	17	10	20	15	10	10	5	4	3	5
1888.	Males	24	310	100	12	13	15	20	11	11	5	4	3	6
	Females	23	199	100	12	22	20	14	8	5	4	6	3	7
1889.	Males	24	362	100	13	11	17	25	10	8	6	3	2	6
	Females	23	310	100	16	17	20	12	8	7	7	4	4	5
1890.	Males	22	325	100	14	12	16	25	16	7	4	3	2	3
	Females	20	199	100	16	16	24	17	11	6	5	1	2	4
Av. 1887-90.	Males	24	1,313	100	12	12	16	23	14	9	6	4	2	5
	Females	22	953	100	15	16	21	15	9	7	5	4	3	5

AGE OF OCCURRENCE OF TYPHOID FEVER.

In studying table 6 relative to age of persons who have typhoid fever, it should be borne in mind that there are more persons living at the earlier ages than at the more advanced ages. After the publication of the census of 1890, it will be possible to compare this table with one exhibiting the per cent of persons living in each period of age, and thus complete the study here provided for by this statement of facts relative to nearly two thousand three hundred cases of typhoid fever.

TWO LINES OF EVIDENCE OF THE PREVALENCE OF TYPHOID FEVER.

In studying the prevalence of typhoid fever in 1890, from the facts presented in the preceding and following pages, it must be borne in mind that those facts are derived from two distinct sources of information:

1.—The numbers of outbreaks, of cases of sickness, and of deaths from typhoid fever are taken from special reports from health officers and other township, city and village officers, during the course of an outbreak, at its close, or in special reports at the close of the year. If all the people and officers reported as the laws provide, the facts presented would represent the *actual numbers* of outbreaks, cases of sickness, and deaths from typhoid fever which occurred in the State during the year; but *all* do not so report. It is just, however, to state that, as the people generally are becoming better instructed in the measures recommended by the State Board of Health for the saving of life and health, better and more complete reports are made year by year. So, each year, we believe that an increasing proportion of the cases of sickness and deaths from the dangerous communicable diseases are reported to this office. This tends towards an apparent increase in the prevalence of the disease each year, modified, of course, by the real fluctuation in prevalence. While waiting for perfect reports, the facts derived from those now received are valuable for purposes of study.

2.—The prevalence of typhoid fever, or of any given disease, as indicated by the "per cent of reports" is taken from the weekly postal-card reports from regular correspondents of the State Board, health officers of cities and villages, and others. The "per cent of reports" is the per cent of the whole number of reports received which stated the presence of the disease named; it gives the relative prevalence of the disease, under the observation of the physicians who report. It may represent the relative area of prevalence of the disease, combined with the relative number of weeks the disease continued where it did occur, *but not the actual number of cases.*

TABLE 7.—*Exhibiting the number of Inches of Earth above the ground water in Lansing, by months for the years 1886–90, compared with the per cent of reported cases and outbreaks of Typhoid Fever in Michigan, for each month; also the total number of cases and outbreaks reported for those years. (Compiled from those cases of which the date of occurrence was given; and from those outbreaks of which the time of beginning was stated.)*

Specifications relative to ground water and Typhoid fever.	Year.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	No. of cases and outbreaks included in this table.
Inches of earth above the water, year 1886	------	276	278	274	272	273	277	282	287	287	286	291	294	----------
Per cent of cases of typhoid fever reported, year 1886 *	------	------	------	------	------	------	------	------	------	------	------	------	------	----------
Per cent of outbreaks which began in each month, 1886	100	6	4	4	2	2	4	11	15	26	11	11	5	253
Inches of earth above the water, year 1887	------	296	287	280	282	285	288	290	291	291	294	297	294	----------
Per cent of cases of typhoid fever reported, year 1887	100	2	1	1	1	2	3	8	20	24	19	12	7	1,096
Per cent of outbreaks which began in each month, 1887	100	5	2	2	3	6	4	12	23	20	11	9	3	289
Inches of earth above the water, year 1888	------	292	298	294	293	293	293	293	290	293	297	294	300	----------
Per cent of cases of typhoid fever reported, year 1888	100	5	3	2	3	3	4	7	13	18	23	11	9	609
Per cent of outbreaks which began in each month, 1888	100	7	5	3	3	4	6	12	15	16	15	6	7	265
Inches of earth above the water, year 1889	------	298	304	304	302	304	299	299	302	305	308	311	312	----------
Per cent of cases of typhoid fever reported, year 1889	100	1	2	1	2	1	2	4	12	28	24	15	7	1,248
Per cent of outbreaks which began in each month, 1889	100	4	2	3	2	2	5	8	17	21	19	11	6	382
Inches of earth above the water, year 1890	------	309	307	305	302	296	292	293	295	300	300	298	300	----------
Per cent of cases of typhoid fever reported, year 1890	100	5	2	2	3	2	2	7	23	18	17	12	6	1,089
Per cent of outbreaks which began in each month, 1890	100	5	4	3	3	6	5	9	25	13	15	6	5	253

* The per cent of cases in each month was not computed in 1886.

The weekly card reports, however, furnish a valuable means of ascertaining, approximately, the relative prevalence of the several diseases in a given year, and the relative prevalence of a given disease in one year compared with other years, and it is as good a scheme for ascertaining the facts as is yet available. Therefore the sickness statistics based upon those weekly card-reports should be relied upon for a comparison of the relative prevalence of typhoid fever in 1890 compared with preceding years. However, the evidence from the two sources may well be compared.

A comparison of the evidence from the two sources, just mentioned, relative to typhoid fever during the years 1886–90, is facilitated by the following Exhibit 1:—

EXHIBIT 1.—*By years for the Six Years 1885–90, the Per cent of Reports (from regular correspondents to the State Board of Health, and others) Stating the Presence of Typhoid Fever in Michigan, also the numbers of Outbreaks, numbers of Localities of Outbreaks, the Cases of Sickness and the Deaths from Typhoid Fever for the Same Years.*

Years.	Per cent of Weekly postal Reports Stating the Presence of Typhoid fever.	Reported Outbreaks of Typhoid fever.	Reported Localities of Outbreaks of Typhoid fever.	Reported Cases of Sickness from Typhoid fever.	Reported Deaths from Typhoid fever.
1885	8	218	200	715	194
1886	8	290	282	1,194	282
1887	10	335	320	2,424	411
1888	10	316	296	*1,511	310
1889	10	432	398	2,530	402
1890	8	330	310	1,924	304

* Inasmuch as it appears that the reported outbreaks and localities in which typhoid fever occurred in 1888 were not very much less than in the preceding year, and were even more than in the year 1886, it is possible that in 1888, the outbreaks of typhoid fever were not allowed to spread as much as in previous years.

THE RELATION OF SICKNESS FROM TYPHOID FEVER TO THE RAINFALL, TO THE GROUND WATER,† AND TO THE HEIGHT OF THE WATER IN WELLS, IN MICHIGAN.

Typhoid fever differs in its mode of spread from some of the other dangerous communicable diseases. It is now most generally believed to be spread by a specific "germ," which is reproduced in the intestines, being conveyed from the bowel discharges of a victim of the disease to the alimentary canal of the second victim. Probably the most usual mode of conveyance for these "germs" is the contamination of the water-supplies by the fecal matter from those sick with this disease. The contamination of the water-supplies, and the virulence of the infected water seem to depend largely on the amount of rainfall and the consequent amount of water in wells which supply water for culinary and drinking purposes. A discussion of this subject from the evidence then collected, was printed in the Report of this Board for the year 1884, pages 88–114. Further evidence has been collected and is presented in the following tables.

† It now appears that the fluctuations in the level of the water in the wells from which water is drawn daily are not the same as in wells from which no water is drawn, and which, therefore, show more accurately the level of the ground water.

TABLE 8.—Typhoid Fever in Michigan.—*Average per cent of weekly card-reports stating the presence of Typhoid Fever, by year and Months for the Ten years, 1878–87, also in each of the six years, 1885–90.*

Period of Time.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs., 1878–87*..	12	10	9	7	5	5	5	7	14	20	22	20	14
1885.....	†8	11	7	5	4	3	5	5	6	11	13	16	8
1886.....	†8	6	3	4	3	5	4	5	13	16	16	13	10
1887*.....	10	6	10	4	3	3	4	8	14	22	18	15	11
1888.....	10	10	7	6	5	4	5	7	12	18	16	12	10
1889.....	10	8	5	3	3	4	5	5	12	19	25	19	12
1890.....	8	6	1	2	2	2	5	6	15	15	16	13	7

* The figures in the line for 1887, and in the line for the average for the ten years 1878–87, in this table do not all exactly agree with those in the same lines in the table printed on page lvi, of the Report of this Board for the year 1888, for the reason that the table printed in the Report for 1888 was made before the cards were all compiled for the *year* and was taken from the compilation (of the card reports first received) for the quarterly reports. The line "Average 10 years 1878–87," included the data for the year 1887 and consequently is not exactly, although it is substantially, the same as in the above table.

† Since May, 1885, physicians have reported only the prevalence of diseases under their *own observation*. Previous to that time diseases which were *believed* to be present (under the care of other physicians) were so reported. This undoubtedly accounts for a part of the sudden decrease in 1885 and 1886 as compared with the preceding years.

Table 8 exhibits the average prevalence of typhoid fever in Michigan by year and months for the ten years 1878–87, and for each of the six years, 1885–90, as indicated by the weekly card reports made by regular observers. Table 9 exhibits the rainfall by months and years for the period of ten years, 1878–87, and for each of the six years 1885–90.

TABLE 9.—Rainfall in Michigan.—*Average number of Inches, by Months, for the Ten Years 1878–87, also in each of the six years, 1885–90.*

Period of Time.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. 10 yrs., 1878–87...	37.27	2.09	2.89	2.28	2.49	3.52	4.24	3.44	3.21	3.72	3.45	2.98	2.69
1885.....	35.82	2.70	.73	.58	2.47	2.30	6.01	2.52	5.82	3.75	3.08	2.90	2.14
1886.....	32.16	3.05	1.72	2.74	2.40	2.58	2.29	1.36	4.21	5.36	1.97	2.35	2.13
1887.....	29.82	2.27	4.47	1.18	1.54	2.25	2.76	2.46	1.98	2.84	2.48	2.10	2.55
1888.....	29.55	1.99	1.77	2.51	2.15	3.73	2.87	2.02	2.38	2.66	2.68	2.92	1.89
1889.....	28.18	2.42	2.04	1.01	1.62	4.21	3.82	3.07	.98	1.85	1.10	3.10	2.96
1890.....	30.20	3.53	2.40	2.12	3.37	4.80	3.74	1.47	3.63	2.09	4.97	2.43	1.70

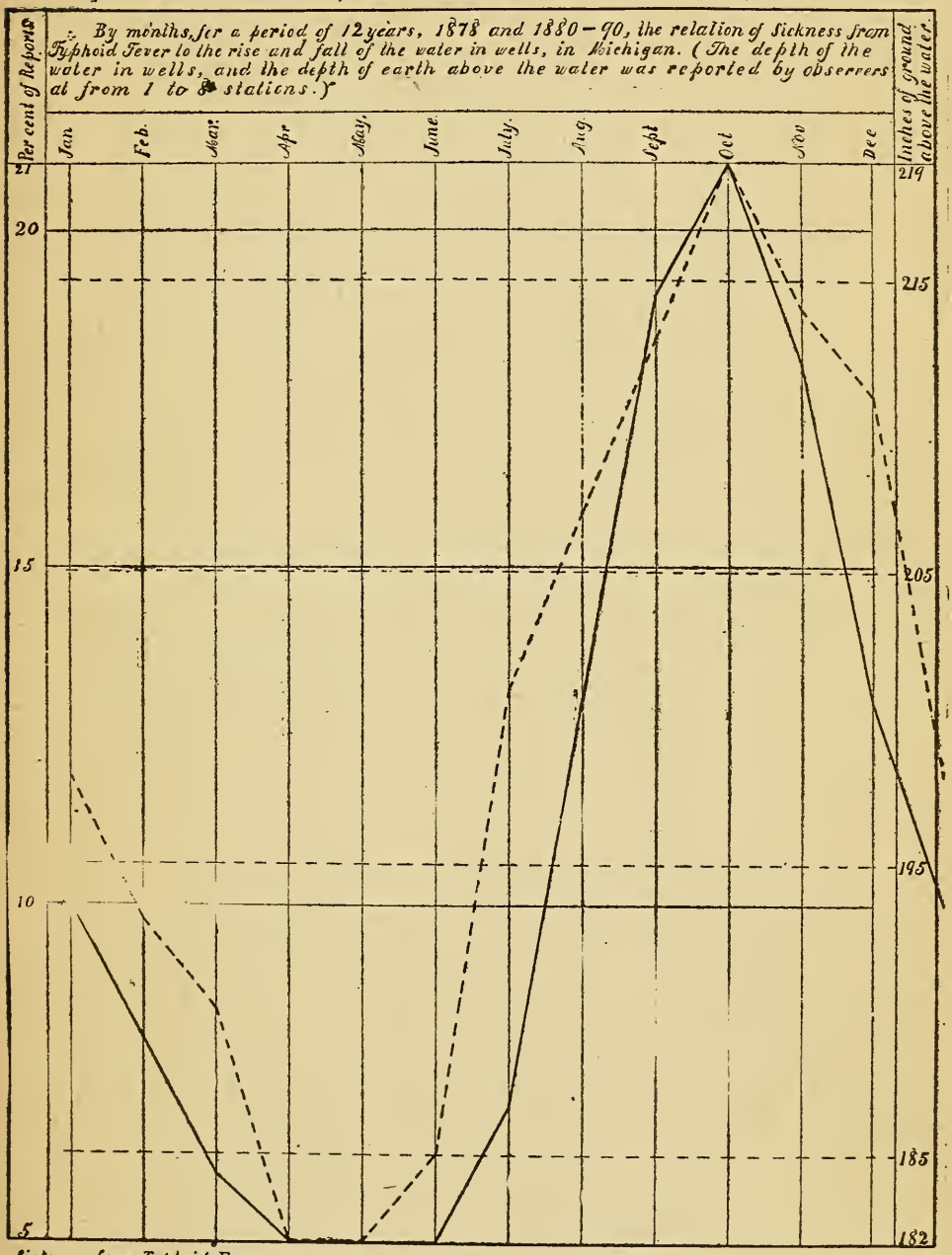
Table 10 exhibits the relation of low water in wells to sickness (as shown by the weekly card reports) and the reported deaths from typhoid fever in Michigan, for the twelve years, 1878, 1880–90. The facts presented in two lines of this table, low water in wells and sickness from typhoid fever, for a ten year period, are graphically represented in a diagram on page 256 of the Annual Report of this Board for 1889.

The diagram, on page 229 of this Report, graphically represents the relation of the sickness from typhoid fever, to the rise and fall of the water in wells, in Michigan, for the twelve-year period comprising the years 1878 and 1880–90.

MICHIGAN STATE BOARD OF HEALTH EXHIBIT.

LOW WATER IN WELLS, AND SICKNESS FROM TYPHOID FEVER, IN MICHIGAN.

By months, for a period of 12 years, 1878 and 1880–90, the relation of Sickness from Typhoid Fever to the rise and fall of the water in wells, in Michigan. (The depth of the water in wells, and the depth of earth above the water was reported by observers at from 1 to 8 stations.)



Sickness from Typhoid Fever ———. *Ground Water* – – – – – – – – – –.

"Indicating what per cent of all reports received stated the presence of Typhoid Fever then under the observation of the physicians reporting.

Over 25000 weekly reports of sickness, and over 500 observations of the depth of water in wells are represented in this diagram.

1878.—The danger from typhoid fever appears to be greatest in October, when the water in wells is lowest, that is, when there are the most "Inches of earth above the ground water." The danger is least in May, when the water in wells is highest.

Comprehensive study of this subject was made by the Secretary of this Board in a paper read before the American Public Health Association, at St. Louis, Mo., Oct. 16, 1884, which was printed in the Annual Report of this Board for the year 1884, pp. 89–114, and the study was continued subsequently, in the Annual Reports of this Board for the years 1888, pp. lv–lvii; 1889, pp. 254–262; 1890, pp. 247–251.

The evidence is conclusive that there is a necessary relation between the low water in wells and the sickness from typhoid fever.

TABLE 10.—*Exhibiting, for Michigan, by Months, during the Twelve Years, 1878, 1880-1890,* the Relation of Low Water in Wells to Sickness from Typhoid Fever; also, the Reported Number of Deaths from Typhoid Fever.*

Month.	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. inches of ground above the water in wells†	200	195	191	183	183	186	202	209	215	220	215	212
Fluctuation from Max. Depth of water in wells	17	12	8	0	0	3	19	26	32	37	32	29
Sickness from Typhoid fever‡	10	8	6	5	5	5	7	13	19	21	18	13
Av. number of reported deaths from Typhoid fever‖	24	21	24	25	24	22	27	58	92	101	72	54

* The data relating to the sickness and the deaths from typhoid fever in the years 1878, 1880–90, were used in order to coincide with the same period for which the measurements of ground above the water in wells were already obtained.

† The year 1879 could not be included as, for that year, there was no station from which reports were received for the whole year. The stations used in the compilation of this line, and the years for which reports were received and compiled from each are as follows: Elsie, 1878; Thornville, 1880–1 and 1885–7; Hillsdale, 1880, 1884, 1887–90; Mendon and Union City, 1880; Linden and Dearborn, 1881; Brockway Center, 1882 and 1883; Otisville and Woodland, 1882; Saginaw City, 1883; Kalamazoo, 1884, 1888 and 1889; Lansing, S. B. of H., 1885–90; Ann Arbor and River Raisin, 1886–90; Alpena, 1887–88; Otsego, 1887; Traverse City, 1888–90; Battle Creek, 1888.

‡ Per cent of weekly reports, from observers in different parts of the State, which stated the presence of typhoid fever.

‖ The data used in the compilation of this line were taken from the Registration Reports of Michigan.—Vital Statistics.

From January to May the fluctuations in the sickness from typhoid fever and the depth of the water in wells are nearly coincident. In June the increase in the sickness follows the decrease of the water with an interval of about a month. Thence during the rest of the year, the agreement of the two is very close. The maximum of sickness and the minimum of water are coincident in October.

The stations at which the measurements of water in wells are taken and the number of years which are available from each station are stated in the dagger (†) footnote at the bottom of Table 10, this page. The Office has been unable thus far to get accurate measurements of the height of water in wells for a long period of years from any stations in Michigan. This absence of extensive data is especially deplored when a comparison of one year with a series of years is desired, but in the averages for a series of years by *months*, the evidence is accurate and valuable.

It is believed that all the wells from which measurements of water are made for this office, except the well at Lansing, are used. The well at Lansing is in the capitol grounds, far enough from other wells so as not to

be liable to be affected by the rise and fall of the water in other wells from daily use, and so would more nearly represent the gradual rise and fall of the *ground water* than would measurements in wells from which water is drawn. But it has been found, by long-continued observations and investigations, that the rise and fall of the typhoid fever is in much closer relation to the fall and rise of the water in wells in actual use than to the fluctuations in the well at Lansing.

TABLE 11.—GROUND WATER.—*Inches of Earth above the Water—by Months for the six years, 1885-90, and for the last four months of the year 1884, and for each of the six years, 1885-90, at* **Lansing**, *Mich.,—Well in the Capitol Grounds.*

Period of time.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
1885-90	292	293	294	292	289	289	288	290	291	293	295	295	297
1884	------	------	------	------	------	------	------	------	------	290	291	293	292
1885	284	288	289	292	280	281	279	282	283	282	285	281	280
1886	281	276	278	274	272	273	277	282	287	287	286	291	294
1887	290	296	287	280	282	285	288	290	291	291	294	297	294
1888	294	292	298	294	293	293	293	293	290	293	297	294	300
1889	304	298	304	304	302	304	299	299	302	305	308	311	312
1890	300	309	307	305	302	296	292	293	295	300	300	298	300

Table 11 exhibits the height of ground above the water in the well at Lansing, by months and year for the six years, 1885–90. In table 13 the first line of table 11 is used, with the average line in the following table (12), together with the average sickness from typhoid fever during the same years.

TABLE 12.—*Temperature of the Water in the Well at the State Capitol in* **Lansing**, *Mich., by Months for the Six Years, 1885-90, and the last four months of the year 1884.*

Year and period of years.	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Av. Six Y'rs, 1885-90.	49	50	47	46	46	48	48	48	50	51	51	52	50
1884	------	------	------	------	------	------	------	------	------	50	51	51	49
1885	47	49	47	43	42	46	48	47	48	50	50	51	45
1886	48	49	47	46	45	46	46	47	50	52	52	51	50
1887	48	50	41	42	46	47	48	49	51	50	51	52	51
1888	49	50	49	48	47	48	48	47	50	51	51	52	51
1889	50	50	49	49	48	49	49	50	50	50	51	51	51
1890	50	50	49	49	48	49	49	49	50	51	51	52	51

TABLE 13.—*Sickness from Typhoid Fever in Michigan (as indicated by the Weekly Card Reports by all Observers) and the depth of Earth (in inches) above the Water in the Well, and the temperature of the water in the Well, at* **Lansing,** *Michigan, by Year and Months for the Six Years, 1885–90.*

	Year.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
Sickness from Tyhoid Fever *	9	8	6	4	3	4	5	6	12	17	17	15	10
Inches of Earth above Water in Well	292	293	294	292	289	289	288	290	291	293	295	295	297
Temperature of water in Well	49	50	47	46	46	48	48	48	50	51	51	52	50

* Per cent of all reports received (from observers in different parts of the State) which stated the presence of typhoid fever.

From table 13 it may be seen that the relation of sickness from typhoid fever to the ground water, as represented by the depth of water in the well at Lansing, is not so close as that which is shown to exist between sickness from typhoid fever and low water in wells in Table 10, on page 230 of this report. It is still possible, however, that if we could obtain measurements of water in *unused* wells in the different localities whence the reports of typhoid fever are derived, or could we have a full and correct report of all cases of the disease which occurred in Lansing during the same period for which we have measurements of the well there, and before there was a general water supply in Lansing, comparison of those data might show the existence of as close affinity between low *Ground-water* and typoid fever, as exists between typhoid and *low water in wells.*

TABLE 14.—*Exhibiting the Average Total Annual Rainfall at Stations in Michigan, the same for Lansing, the inches of Earth above the Ground Water at* **Lansing,** *the Inches of Water in an undisturbed Well at Lansing, and the Reported Sickness from Typhoid Fever in Michigan, as indicated by the per cent of all the weekly card-reports which stated the presence of Typhoid Fever.*

Year, and period of years.	Av. Total Annual Rainfall at Stations in Michigan, in inches.	Total Annual Rainfall at Lansing, in inches.	Inches of Earth above the Ground Water at Lansing.	Inches of Water in an unused Well at Lansing.	Ground Water, higher (+) or lower (−) than the six years' Average in inches.	Av. Per Cent of all Weekly Card-Reports Stating the presence of Typhoid Fever.	More (+) or less (−) Sickness from Typhoid Fever than the six years' average.
Av. 6 Y'rs, 1885–90	30.96	29.15	291	32	=	9	=
1885	35.82	34.51	284	40	+ 7	8	−1
1886	32.16	29.52	281	42	+10	8	−1
1887	29.82	30.08	290	34	+ 1	10	+1
1888	29.55	25.76	294	29	− 3	10	+1
1889	28.18	23.28	304	19	−13	10	+1
1890	30.20	31.73	292	28	+ 1	8	−1

Table 14 is a summary of the facts presented in tables 8 and 9, with the addition of the facts relative to the height of water in the well at Lansing.

From the evidence given in this table (14) it appears that, notwithstanding increased population and more numerous and better reports from local health officials, the reported prevalence of typhoid fever in Michigan was less in 1890 than in either of the previous three years; and also than the average for the six years 1885-90. The rainfall, both throughout the State and at Lansing, was greater in 1890 than for either of the previous three years: and at Lansing was more than the average for the six years 1885-90. In this connection, it is proper to hold in mind the fact that the efforts of the State Board of Health, the issuing of leaflets, diagrams and other literature bearing upon the restriction and prevention of typhoid fever, have continued for a number of years, and there is reason to believe that the influence of that work is increasing; possibly, if it were not for that work, the typhoid sickness during 1890 might have been as much or more, than in the preceding years, notwithstanding increased rainfall and water in wells.

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Typhoid fever [illegible]